Appendix D

CZT Logging Field Reports, Boreholes 41-09-39 and 41-09-04

High-Rate Gross-Gamma Survey Log

Borehole 41-09-39

Geophysical Calibration and Survey Performed by:

J. E. Meisner Electronics Engineer
J. R. Kunk Logging Technician
G. L. Lekvold Physical Scientist
R. K. Price Data preparation and report

1.0 INTRODUCTION AND PURPOSE

MACTEC-ERS requested a high-rate, cadmium-zinc telluride (CZT) gamma-ray survey of SX Tank Farm borehole, 41-09-39. Work Order number E62018.

At the request of MACTEC-ERS, the log survey data acquired and presented in this report is qualitative and provides a relative indication of the gamma-ray flux in the formation as a function of depth in the borehole. Copies of the field notes and graphical representation of the survey data are included in this report.

The logging detector was calibrated in four borehole uranium calibration models located at Hanford (SBA, SBB, SBL, and SBH).

2.0 EQUIPMENT DESCRIPTION

The CZT detector-assembly is installed in the same borehole sonde as the HPGe-10% detector. The CZT detector is positioned 1.25 ft above the center of the HPGe detector. The location of the CZT detector within the borehole probe housing was measured with the internal components disassembled. The CZT detector location was then verified with count-rate measurements from a button source placed at various positions along the probe length and around the probe axis. Finally, the CZT detector location was marked on the outside of the probe housing. The detector information and operating specifications are given in Table 1.

Table 1: Cadmium-zinc Telluride Borehole Detector

Cadmium-zinc Telluride (CZT) Detector Assembly	
Rust-NW ID =	RLSCZT2.0
Serial no. =	eV-11761
Lot no. =	L1545
Crystal Size =	3 mm * 3 mm * 1 mm
Operating Bias =	120 volts
Signal Shape Time =	0.5 usec
MCA =	512 channels

The CZT crystal can be used for gamma-ray spectroscopy, however the bias voltage and electronics components required for discriminating the various types of signal pulses was not use for the calibration and borehole survey. The electronics and reduced bias voltage is appropriate for gross gamma-ray counting. The detector signal is processed by a multi-channel analyzer for reviewing and monitoring system performance. The spectra is characterized by rapid degradation of detector efficiency with increasing gamma-ray energy. This characteristic is due to the small volume of the detector and high percentage of gamma-rays that are not completely absorbed by the crystal. The bias voltage setting is optimized for low signal noise. The lower level discriminator of the signal shaping amplifier is set at approximately 100 KeV. There is a small amount of gamma-ray count roll-off around 100 KeV present in the MCA spectra from photo-electric absorption. A sample spectra is shown in Figure 1.

The CZT detector is known to be temperature sensitive, and is characterized by electrical conductance breakdown with high current draw from the bias voltage supply. When detector diode breakdown occurs the MCA spectra contains excessive low-energy channel counts (signal noise). If breakdown is not excessive the detector can be recovered by removing the bias supply voltage and allowing the detector-assembly to cool.

High temperatures in the 41-09-39 borehole caused some diode breakdown. The tool was returned to the ground surface to

thermally cool. There was apparently no permanent damage to the detector.

3.0 CZT RESPONSE IN BOREHOLE CALIBRATION MODELS

Borehole calibration measurements were taken in four gamma-ray calibration models on January 8, 1997. The assigned radionuclide concentrations are reported in Stromswold (1994) for the Hanford Borehole Calibration Models. The logging probe position in the center of the borehole calibration zones was the mid-point of the CZT detector. The assigned concentration of the calibration models is given in Table 2.

Table 2: Borehole Calibration Model Concentrations

MODEL	CONCENTRATION* ^{226}Ra (pCi/g)	Depth-Center (ft)
SBA (upper)	61.2 +/- 1.7	8.5
SBL (upper)	324 +/- 9	8.5
SBB (lower)	902 +/- 27	17.5
SBH (lower)	3126 +/- 180	17.5

* - Uncertainties are 95% confidence intervals.

The CZT detector response in each model is presented in Table 3. Field notes of the calibration file names and model names is attached.

Table 3: CZT Response In The Calibration Models

SBA		SBL		SBB		SBH	
Cnts	LT(sec)	Cnts	LT(sec)	Cnts	LT(sec)	Cnts	LT(sec)
747	399.98	2997	299.94	5154	199.90	15937	199.74
754	399.98	2909	299.94	5198	199.90	15693	199.74
780	399.98	2836	299.94	5206	199.90	15868	199.74
772	399.98	2910	299.94	5137	199.90	15725	199.74
763	399.98	2971	299.94	5135	199.90	15828	199.74
734	399.98	2871	299.94	5206	199.90	16021	199.74
730	399.98	2897	299.94	5186	199.90	15863	199.74
753	399.98	2908	299.94	5243	199.90	15861	199.74
702	399.98	2936	299.94	5265	199.90	15554	199.74
789	399.98	2892	299.94	5129	199.90	15886	199.74
Avg = 1.88 cps		Avg = 9.71 cps		Avg = 25.99 cps		Avg = 79.22 cps	

The count-rate activity with the detector suspended in air is near zero counts per second (0.04 cps), as expected (spectra CZT12000.CHN). The computed calibration coefficient for each model is presented in Table 4.

Table 4: CZT Calibration Coefficient

Model	Concentration (pCi/g)	Count Rate (cps)	Calibration Coefficient (pCi/cps)
SBA	61.2 +/- 1.7	1.88	32.54
SBL	324 +/- 9	9.77	33.36
SBB	902 +/- 27	25.99	34.71
SBH	3126 +/- 180	79.22	39.46

Calibration measurements have not been performed to validate the dead-time correction applied by the counting system electronics components. This is a concern because, the electronics corrected count rates with the HPGe detectors is known to be incorrect when count-rates exceed 30% system dead-time.

4.0 CZT SURVEY OF BOREHOLE 41-09-39

The CZT borehole survey of 41-09-39 was acquired on January 16, 1997. A second survey was acquired on January 21, 1997, due to problems with the initial CZT survey, from high borehole temperature cause detector diode breakdown. The logging probe was centered in the borehole. The HPGe-10% shielded germanium detector is present in the same borehole probe. The zero depth reference was established at the ground level and the center of the HPGe-10% detector. The depth recorded in the CZT spectra files is corrected for the depth difference to the HPGe detector. It was requested to log the entire depth of the borehole. Logging began from the zero depth reference (ground level) with fixed winch velocity of 0.7 ft/min and spectra recorded each 0.5 ft down the hole.

The CZT detector responses were recorded in spectra containing 512 channels. A sample spectra of the borehole survey in the high contamination zone is shown in Figure 2. The CZT spectra can be used to indicate that the dominant gamma-ray source in the high contamination interval is ^{137}Cs, which supports the MACTEC-ERS high resolution spectral gamma-ray survey of the adjacent intervals. Other radionuclides, if present, were not easily

detectable.

The CZT system in the high gamma-ray activity zones did not saturate which can occur in HPGe system, but blank spectra can be recorded with erroneous live-time values. There were problems with the CZT survey. A summary of the logging activities for the first CZT survey of 41-09-39 is given in Table 5.

Table 5: CZT Gamma-Ray Borehole Survey Activity Summary (January 16, 1997)

Borehole Size = 7" OD
Casing Thickness = 0.5"
Casing Type = carbon steel

Depth Datum Reference = Ground Level
Depth Increment = 0.5 ft

Start Time	Depth Range	Log Mode	Spectra Number	Comments
10:28	0-74	Fixed 0.7fpm	000-148	Stopped due to S/W Lockup
12:18	70-74	Fixed 1.0fpm	149-157	Stopped due to S/W Lockup blank file @ lockup depth
12:27	74-74	Fixed 1.0fpm	158	Stopped due to S/W Lockup Blank files
12:34	130-107	Fixed 1.0fpm	159-206	Stopped due to CZT noise from high temp
13:58	110-94	Fixed 1.0fpm	207-238	Stopped due to Watch-Dog timer sounding alarm, reset CPU
14:20	94-84	Fixed 1.0fpm	239-260	Stopped due to S/W Lockup blank file @ lockup depth
14:33	84-84	Fixed 1.0fpm	262-266	Turn off HPGe, Still Lockups multiple attempt blank files

14:41	70-74	Fixed 1.0fpm	267-281	S/W Lockup multiple attempt, blank file @ lockup depth
14:55	73-86	MSA 20sec	290-316	Move-Stop-Acquire mode through Highest Activity Zone

Three types of problems were encountered that compromised the survey data acquired January 16, 1997. Field Survey Data Sheets are attached. The problems are discussed below.

(1) Logging in the fixed velocity mode progressed from 0 ft to 74 ft with out incident. At 74 ft (spectra no. 148) the high count rate activity of the CZT prevent the micro-processor in the MCA from responding to requests from the computer program, "LOG". This resulted in locking-up the computer program, preventing it from monitoring the probe depth, saving the spectra to disk, and restarting the MCA for the next successive depth increment. The computer program had to be restarted. It was identified that by cycling the bias voltage power supply for the CZT, the computer program would save the last spectra that was being collected. However, further review of this last spectra revealed that the ending depth was not properly recorded and was therefore invalid. The invalid spectra recorded when the computer locked up must be removed from the survey results (files 149-158,261-281).

(2) After over two hours in the high temperature environment the current draw at the bias power supply increase by over three fold and signal noise was observed at the low energy end of the spectra. A sample spectra showing the signal noise is shown in Figure 3. Power to the probe was shut off, the probe was returned to the surface to cool-down for one hour before logging continued. CZT detector break-down from high temperature is not normally considered dangerous to the detector. However, temperatures in the electronics component must be lowered to continue operation in these hostile environments. Spectra with signal noise are invalid and were removed from the final version of raw data. The invalid spectra are: (files 178-182, 188-197, and 202-206). All spectra acquired after the one hour cool-down were reviewed

and no signal noise was observed.

(3) The dead-time correction circuitry in the amplifier and MCA have been examined with the operation of the HPGe detectors and is considered acceptable (less than the counting uncertainties) when the dead-time is less than 30%. The highest count-rate observed in borehole 41-09-39 was 430,000 cps (14,500,000 pCi/g eRa-226) with a 92% dead-time, the accuracy of such a measurement is unknown.

The second CZT survey of 41-09-39 was acquired on January 21, 1997. Through the zone of highest gamma-ray activity the move-stop-acquire mode was used to prevent computer lockup. The survey was a success, problems with the first survey did not occur, (ie. computer lockup and high temperature detector break down). A plot of the first and second survey is presented in Figure 4. A summary of the logging activities for the second CZT survey of 41-09-39 is given in Table 6.

Table 6: CZT Gamma-Ray Borehole Survey Activity Summary (January 21, 1997)

Borehole Size = 7" OD Casing Thickness = 0.5" Casing Type = carbon steel Depth Datum Reference = Ground Level Depth Increment = 0.5 ft				
Start Time	Depth Range	Log Mode	Spectra Number	Comments
10:28	130-87	Fixed 1.0fpm	000-088	No Problems
12:18	95-60	MSA 20 sec	089-158	No Problems

Data from the HPGe system was also collected but had saturated the counting system electronics at the same intervals as the MACTEC-ERS spectral system. The HPGe data is not presented in this report.

5.0 REFERENCES

Stromswold, D.C., 1994, *Calibration Facilities at Hanford for Gamma-Ray and Fission-Neutron Well Logging*, PNL-9958, Pacific Northwest Laboratory, Richland, Washington

Prepared by:_____ _____

J. E. Meisner, Principal Engineer Date

Sample CZT Spectra from 41-09-39

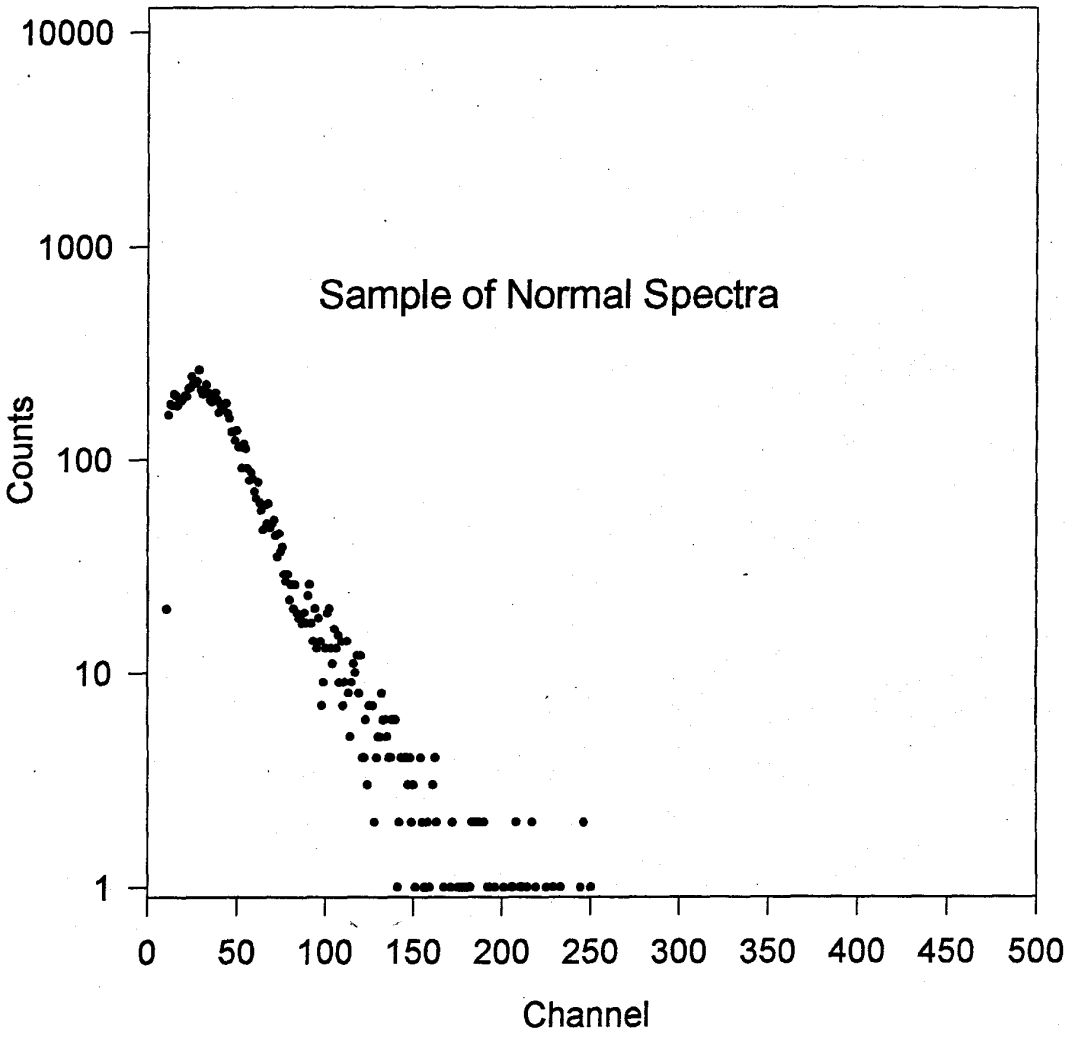


Fig 1

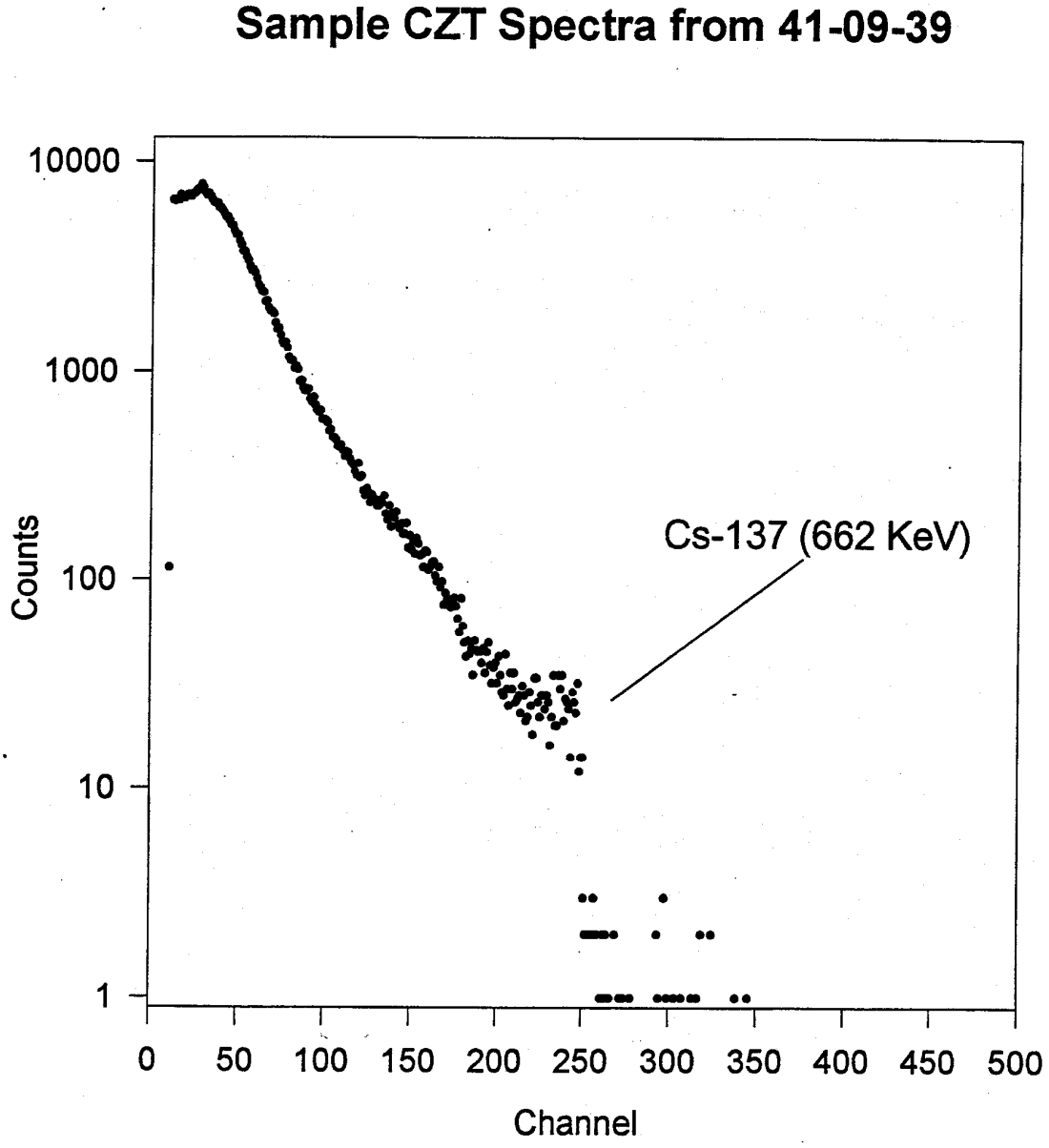

Sample CZT Spectra from 41-09-39
10000
1000
100
10
1
Counts
Cs-137 (662 KeV)
0
50
100
150
200
250
300
350
400
450
500
Channel

FIG 2

Invalid CZT Spectra from 41-09-39

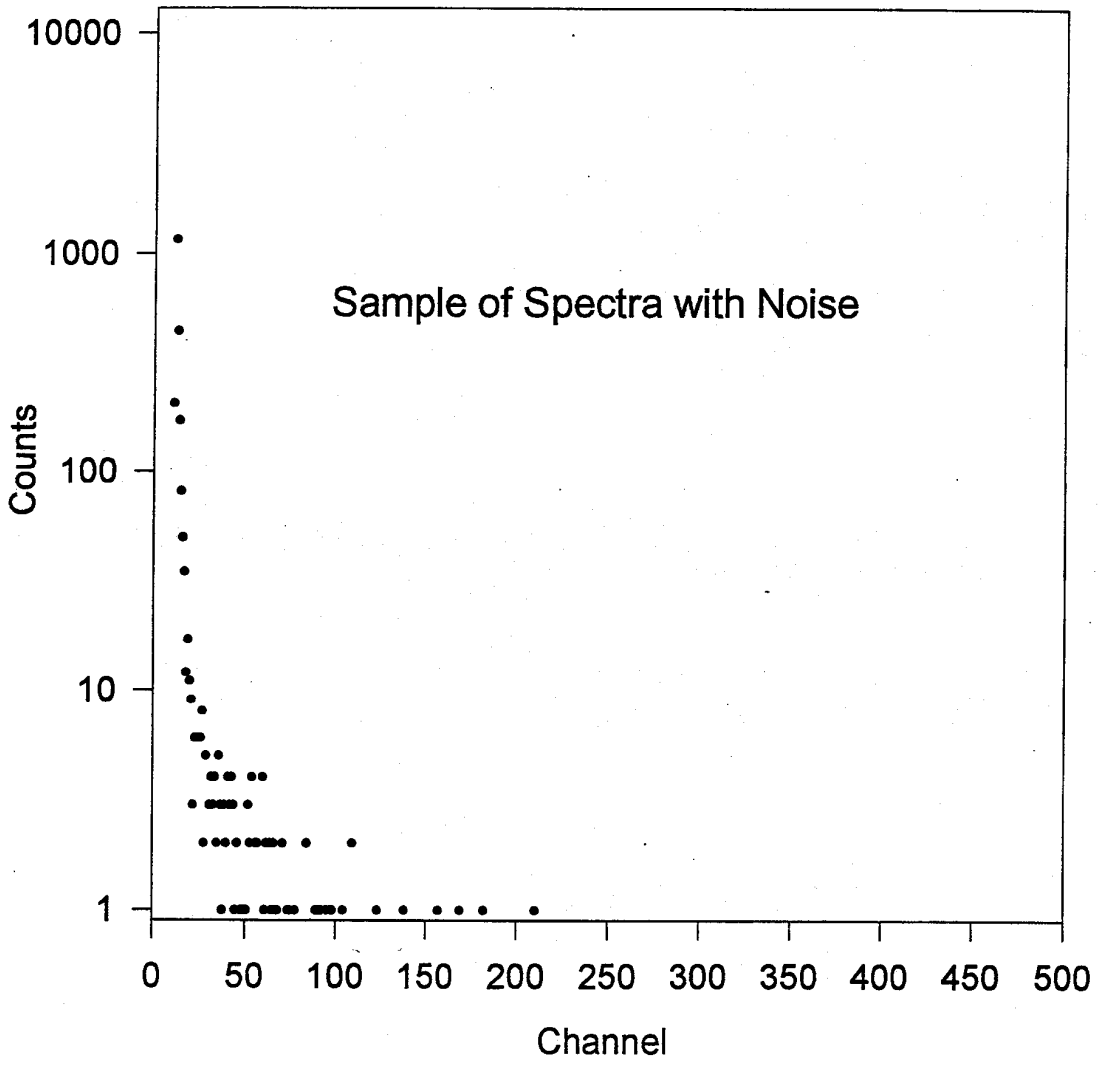


Fig 3

CZT Gamma-Ray Borehole Survey

Location : SX Tank Farm Log Date: Jan 16, 1997 (line, fine)

Borehole: 41-09-39 Jan 21, 1997(BOLD, dashed)

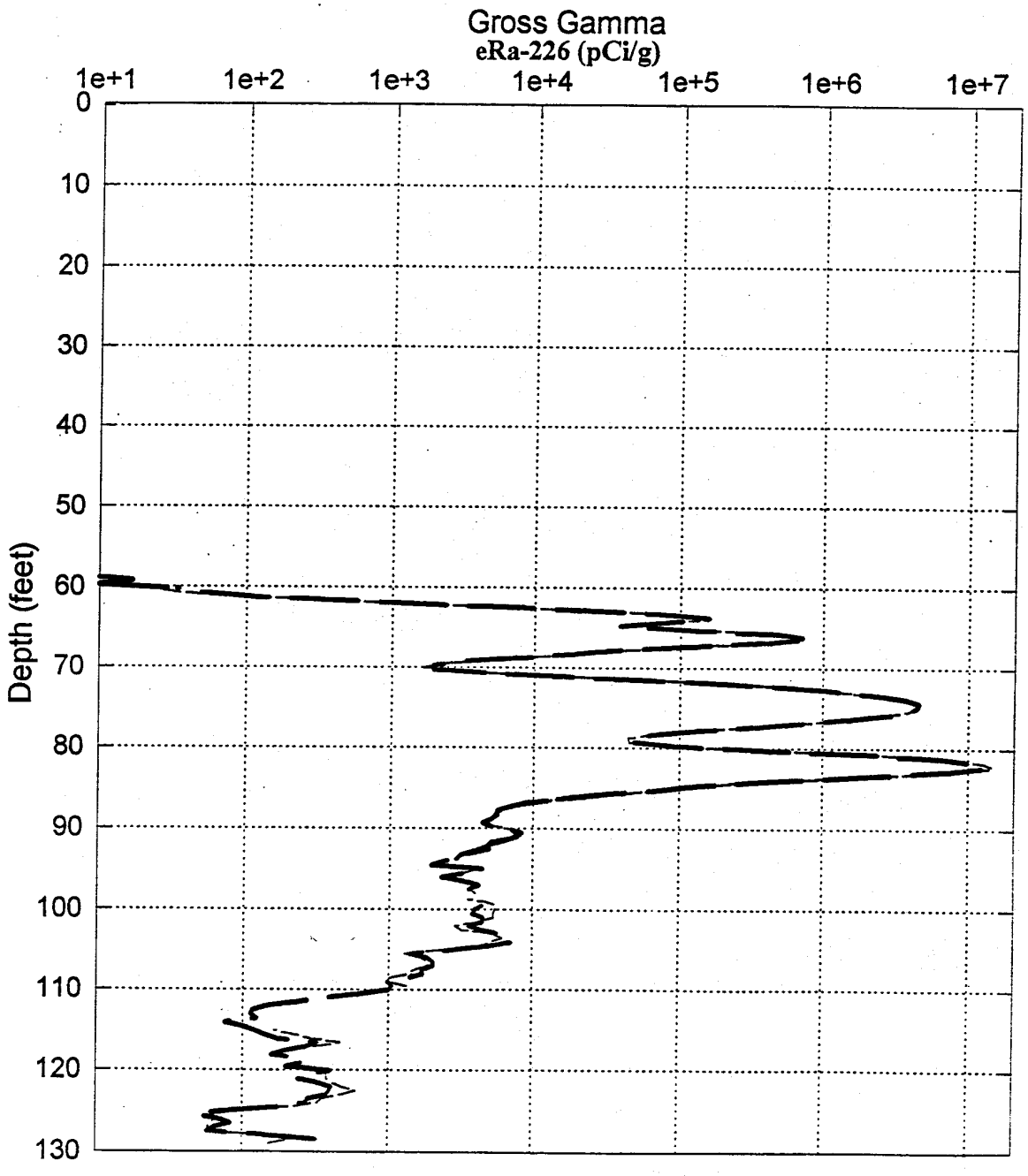


FIG 4

CZT Cal Jan 8, 1997

7-HPGE Gain from 50 X 6.78 (course, fine) To 50 X 7.45

CZT Gain Set to 10 course X ~~5.75 fine~~ 5.40

Bias voltage 120 V

Noise level of CZT at about 100 m Volt

Cs-137 peak in channel ~~927~~ 1092 (GK JRK 1/8/97) HPGe

K40 peak in channel ~~2054~~ (GK) 1092 (JRK) HPGe

CZT re Gain to 10 X 5.40

calibration source Cs 137 place on CZT

Activity 2.00e-04 Ci (200 uCi)

Serial # 1013

Date assay 4/1/97

Custodian K.L. Dunn

Zero depth w.r.t. CZT at top of casing

Prefix	Model	Depth	Time	#	Comments
CZT1	calibration	surface	300 Sec	1	used Cs 137 source
CZTH	SBH	~~17.5 ft~~ (JRK 1/8/97) 17.5 ft	200 Sec	10	NONE
CZTL	SBL	8.5 ft	300 Sec	10	NONE (Clenagmbs CZT1100.CHN & CZT1210.CHN)
CZT1	Back Ground	surface	500 Sec	1	NO SOURCE
CZTB	SBB	17.5 ft	200 Sec	10	NONE
CZTA	SBA	8.5 ft	400 Sec	10	NONE
CZT1	calibration Cs-137	surface	300 Sec	1	files CZT11CAA.CHN CZT12CAA.CHN
CZT1	check source (Coleman2)	surface	300 Sec	2	coleman manuels CZT1200, -1201 No CZT response - too low

SOURCES POSITIONED OVER CZT (ID LOCATION 1" BELOW & 90° INCREMENTS)

All times are real time except the records with the coleman manuels which are live time

ADC LLD at 0.085 VDC

ADC Zero at 0.000 VDC

Joseph M Graham Jan 8, 1997

BOREHOLE SURVEY DATA SHEET

Page 1 of 2

Project: SX Tanks | Well Name: New | Well ID: 41-09-39

Date: 01/16/97 | Location: SX Farms

Notes:

Diode Bias Current –

Depth	Time	Id
0'	10:30	2 ua
118'	12:45	16 ua
110	13:00	718ua – Breakdown
83	11:30	8 ua

Gas Flow

Depth	Flow
13'	770 ml/min
73'	882 " "
110'	960

CZT noise @ 30°F = 0.1 V p-p

BOREHOLE LOGGING INFORMATION

Logger: J. Meisner | System Calibration Configuration:

Depth Datum Reference: Ground Level

		Casing: Diameter	Casing: Wall Thickness		
Water Level: N/A ft	Source: Driller	7.0 in.	0.5 in.	Total Depth: 130.5 ft	Stickup: 0 ft
		/ in.	/ in.	Total Depth: / ft	Stickup: / ft
Total Depth: 130.5 ft	Source: Previous log	/ in.	/ in.	Total Depth: / ft	Stickup: / ft
		/ in.	/ in.	Total Depth: / ft	Stickup: / ft

File Name Prefix: B101 | Field Disk/Part. D: | Return Error: Ø in. (High/Low) at 0 ft

Pre Log Calibration 458 Source / 303 BG | Post Log Calibration | Field Verifier ID: Gelman/EZ

Log Interval: Fix Speed	0.1 fpm	Move - Stop - Acquire	N/A s (LT/RT)	Remarks: Max well Temp = 130°F		
Depth Range: Start	Ø ft	Stop 74.5 ft Erased out	Incr 0.5 ft			
Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	N/A s (LT/RT)			
Depth Range: Start	70 ft	Stop 74.5 ft Erased out	Incr 0.5 ft			
Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	N/A s (LT/RT)			
Depth Range: Start	74 ft	Stop 74.5 ft Erased out	Incr 0.5 ft	← CZT only		
Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	N/A s (LT/RT)	← Both det – Pulled tool to cool CZT		
Depth Range: Start	130.5 ft	Stop 107 ft	Incr 0.5 ft			
Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	N/A s (LT/RT)			
Depth Range: Start	110 ft	Stop 94.7 ft	Incr 0.5 ft	Stopped to reset CPU		

LOGGING EQUIPMENT WAS CLEANED AS DESCRIBED IN WHC-CM-7-7, Ell 11.1.

Prepared By (print/sign name): James Meisner / James Meisner Date: 1/16/97

A-6000-663 (02/95)

BOREHOLE SURVEY DATA SHEET

Page 2 of 2

Project: SX Tanks | Well Name: New Well | Well ID: 41-09-39

Date: 01/16/97 | Location:

Notes:

BOREHOLE LOGGING INFORMATION

Logger: J. Meisner | System Calibration Configuration:

Depth Datum Reference: Ground Level

Water Level: N/A ft	Source	Casing: Diameter: 7.0 in.	Casing: Wall Thickness: 0.5 in.	Total Depth: 130.5 ft	Stickup: 0 ft
		in.	in.	Total Depth: ft	Stickup: ft
Total Depth: 130.5 ft	Source Prev. Log	in.	in.	Total Depth: ft	Stickup: ft
		in.	in.	Total Depth: ft	Stickup: ft

File Name Prefix: B101 | Field Disk/Part. D | Return Error: 0 in. (High/Low) at 0 ft

Pre Log Calibration | Post Log Calibration | Field Verifier ID: Coleman

Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	NA s (LT/RT)			
Depth Range: Start	95 ft	Stop	84.5 ft	Incr	0.5 ft	
Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	NA s (LT/RT)			
Depth Range: Start	70 ft	Stop	74.5 ft	Incr	0.5 ft	
Log Interval: Fix Speed	NA fpm	Move - Stop - Acquire	20 s (LT/RT)			
Depth Range: Start	73 ft	Stop	86 ft	Incr	0.5 ft	
Log Interval: Fix Speed	fpm	Move - Stop - Acquire	s (LT/RT)			
Depth Range: Start	ft	Stop	ft	Incr	ft	
Log Interval: Fix Speed	fpm	Move - Stop - Acquire	s (LT/RT)			
Depth Range: Start	ft	Stop	ft	Incr	ft	

Remarks:
- Locked up
- CZT only
- locked up's
- changed to MSA

LOGGING EQUIPMENT WAS CLEANED AS DESCRIBED IN WHC-CM-7-7, Ell 11.1.

Prepared By (print/sign name): James Meisner / James Meisner Date: 01/16/97

BOREHOLE SURVEY DATA SHEET

Page 1 of 1

Project: New Borehole | Well Name: SX New Borehole | Well ID: 41-09-39

Date: 01/21/97 | Location: SX Tank farm.

Notes: LNgas @ start 823
Bias Current @ start .02
After LN2= 970
Bias I = .13

BOREHOLE LOGGING INFORMATION

Logger: J. Meisner | System Calibration Configuration: WHC-SD-EN-TI-293

Depth Datum Reference: Ground level

Water Level: NA ft	Source Previous	Casing: Diameter: 7.0	in.	Casing: Wall Thickness: 0.5	in.	Total Depth: 1305	ft	Stickup: 0	ft
			in.		in.	Total Depth:	ft	Stickup:	ft
Total Depth: 1305 ft	Source Previous		in.		in.	Total Depth:	ft	Stickup:	ft
			in.		in.	Total Depth:	ft	Stickup:	ft

File Name Prefix: B102 | Field Disk/Part. D: | Return Error: 0 in. (High/Low) at 0 ft

Pre Log Calibration _____ | Post Log Calibration ~~B~~ 280 1 Cal 440 1 | Field Verifier ID: Coleman L&R

Log Interval: Fix Speed	1.0 fpm	Move - Stop - Acquire	NA s (LT/RT)	Depth Range: Start	1305 ft	Stop 87 ft	Incr 0.5 ft
Log Interval: Fix Speed	NA fpm	Move - Stop - Acquire	20 s (LT/RT)	Depth Range: Start	95 ft	Stop 60 ft	Incr 0.5 ft
Log Interval: Fix Speed	_____ fpm	Move - Stop - Acquire	_____ s (LT/RT)	Depth Range: Start	_____ ft	Stop _____ ft	Incr _____ ft
Log Interval: Fix Speed	_____ fpm	Move - Stop - Acquire	_____ s (LT/RT)	Depth Range: Start	_____ ft	Stop _____ ft	Incr _____ ft
Log Interval: Fix Speed	_____ fpm	Move - Stop - Acquire	_____ s (LT/RT)	Depth Range: Start	_____ ft	Stop _____ ft	Incr _____ ft

Remarks: Cal @ 1' above ground

LOGGING EQUIPMENT WAS CLEANED AS DESCRIBED IN WHC-CM-7-7, EII 11.1.

Prepared By (print/sign name): James Meisner / James Meisner | Date: 01/21/97

A-6000-663 (02/95)

CZT LOGGING OF 41-09-04

Test Date: February 4, 1997

Conducted By: G. L. Lekvold / Physical Scientist
J. E. Meisner / Principal Engineer (Rust Fed Serv.)

Introduction: This test consisted of logging borehole 41-09-04 in the SX tank farm by utilizing the RLS-2 logging system and the CZT sonde.

Purpose of Test: The purpose of this test was to acquire Gamma Ray logging data from a very high activity region of the vadose zone using a very low efficiency detector (CZT). This test was conducted to correlate the vadose zone contamination information with previous data, which was collected with other systems and detectors, in this and adjacent boreholes.

Test Conditions: The weather was clear and dry, with an ambient temperature of approximately 45 deg. F. The borehole is located in a special corridor which was created to facilitate the drilling of two "new" boreholes. The area surrounding the borehole has been surveyed and declared "clean".

The borehole has a single steel casing with an I.D. of 6", and a wall thickness of 1/4". (See previous spectral gamma log data report for a description of the borehole construction; GJPO, 1996)

Historical documentation indicated that this borehole had known contamination, so the decision was made to sleeve the sonde and the logging cable. Operator support was provided by Bill McFee and HPT support was provided by Pat Howard. The area inside the valve box, (installed around boreholes prior to gravel fill in the tank farm), was considered a controlled zone. Entry into that zone was all performed by the operator and the HPT.

The sonde was sleeved with a double layer of plastic, and approximately 115' of cable was sleeved with a single layer. A protective layer of duct tape was placed at the location where the centralizer was clamped.

Test Equipment: The RLS-2 logging system is operated by Rust Federal Services personnel (J. Meisner). The downhole probe contains a CZT and Germanium detector. The Germanium detector was not utilized during this test. Pre and Post Field Verifications were not performed since there is no source available with sufficient activity. Documentation on the CZT detector is provided in High-rate gross-Gamma Survey Log, Borehole 41-09-39. Documentation on a simple calibration to equivalent uranium concentration units is provided in a previous physics test report on the CZT logging of borehole 41-09-39.

Test Method: The CZT sonde is particularly sensitive to thermal effects. This borehole is known to have areas of relatively high temperature. For those reasons the decision was made to lower the sonde to total depth (TD), as rapidly as possible, and then to log up through the primary area of interest.

Data were acquired in a move-stop-acquire, and "real time" data acquisition mode. Changes were made to the counting interval based upon the observed count rates. The detector bias current was monitored and the baseline noise threshold was monitored on an oscilloscope to check for detector breakdown due to thermal effects.

Logging was commenced at 101.0', with a Real Time interval of 30 seconds and a depth interval of .5'. At a depth of 80.0' the Real Time interval was decreased to 25 seconds based upon the high count rate. At a depth of 55.0' the count rate had decreased substantially, indicating that the zone of greatest activity had been logged through. At that point, the decision was made to lower the sonde back down to 75.0' for a repeat run.

The Real Time interval was reset back to 30 seconds and logging commenced from 75.0' upward. Logging continued in this mode until approximately 63.0' when detector breakdown occurred due to thermal effects.

Due to a failure to reset the depth counter in the computer to the center of the CZT detector, an error is present in all of the recorded depths. In order to correct for the depth error, 1.25' should be added to all recorded depths.

Test Results: Data which were recorded show several peaks of significant Gamma Ray activity in the area between approximately 55' and 85'. Initial "quick-look" information shows a good correlation between the data gathered during this test and previous data which was obtained with other logging systems and detectors.

As the logging progressed upward, the sleeving was surveyed and removed by the HPT and the Operator. The upper 80' of sleeving was relatively uncontaminated, with levels of activity ranging between 100 counts per minute (cpm), and background. The lower 20' of sleeving, however, had rapidly increasing levels of contamination which were in excess of 1000 cpm. As a result of this contamination, the centralizer was discarded and processed as radioactive waste.

Test Data: All test data was recorded on the hard drive in the RLS-2 system and then copied onto a 3.25" floppy diskette. There are 118 data files from **B1072000.CHN**, at 101' to **B1072093.CHN,** at 55.0', and **B1072094.CHN,** at 75.0' to **B1072118.CHN** at 63.0'. This data will accompany this test report. Since the RLS system is equipped with the hardware and software required to produce a plot of the data, a field check plot was produced to provide preliminary information as to proper operation of the system. That plot is provided as Figure 1.

Summary: All equipment and systems operated correctly during this test and good data were collected. Additional valuable information was gained in conducting logging operations under conditions of elevated borehole temperatures and smearable contamination.

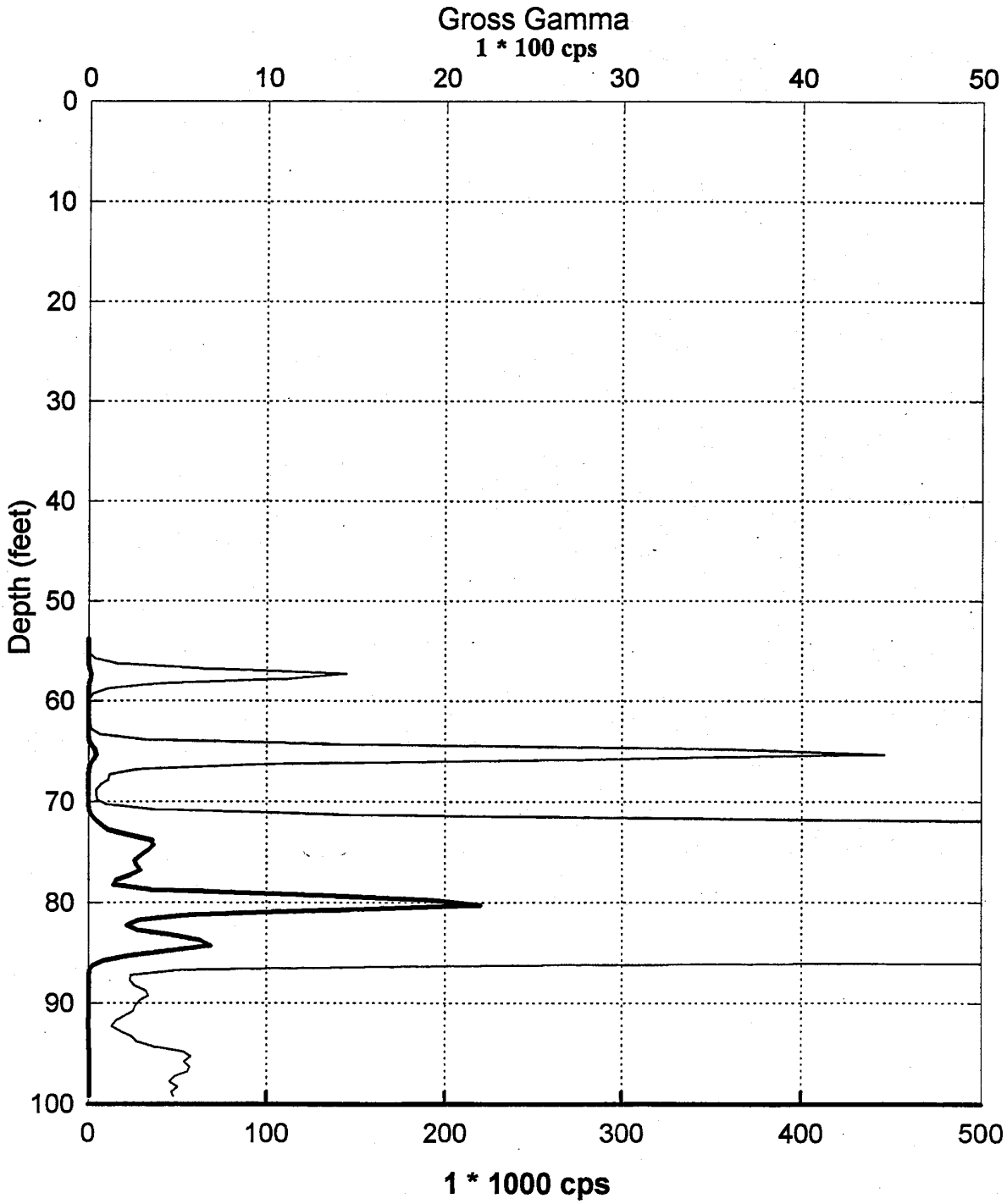
This report was submitted by Gary L. Lehnold on 2/6/97

CZT Gamma-Ray Borehole Survey

Location : SX Tank Farm

Log Date Feb. 4, 1997

Borehole: 41-09-04



OPER Bill McFee

HPT Pat Howard

STOP 80'

clay sample to 25"

10:55

~~85~~ 85'

23000 CPS @ 78.5'

20ua @ 101'
30ua @ 99.5'
50ua @ 76.5'

73' 3900CPS

64.5' 65 CPS

63.5' 10 CPS 60ua @ 11:10

61.5' 4 CPS

58.5' 1450 CPS 70ua @ 11:15

57.5' 160 CPS

56.5' 10CPS

56.0' 2 CPS

55.0' 1 CPS

11:22 STOP GO BACK DOWN TO 75.0' FOR AELOG
→ INCREASED COUNT INTERVAL TO 30"
11:25 START LOGGING UP B1072094 FILE 35,500 CPS 80u

73.0' 4100CPS

72.0' 370 CPS

66.0' 3690CPS
61.5' 11:40 100ua 6CPS TOOL STARTING TO BREAK DOWN DUE TO BOREHOLE TEMPERATURE